Coexisting electronic order in the ultra-quantum limit of graphite

Dr. Aldo Isidori
(Royal Holloway University, London, United Kingdom)

Abstract:
Semimetals like graphite have recently received renewed interest as they not only are able to host topologically non-trivial phases but also can be driven into the ultra-quantum limit by magnetic fields achievable in modern-day laboratories. Thus, they provide insight into quantum-Hall physics and the physics of massless Dirac fermions in three dimensions. They also represent ideal model systems for studying magnetic-field driven density wave instabilities, as the onset field for such collective excitations is suppressed in semimetals. Using pulsed high-magnetic fields up to 60 T applied to a single crystal of natural Tanzanian graphite, we find a series of field-induced phase transitions into collinear charge-density wave states resulting from enhanced interactions between the lowest four Landau levels. By analysing magneto-transport data and calculating the renormalized Landau level structure at high fields, we establish the phase diagram of graphite in its ultra-quantum limit. Our results imply the existence of a novel topologically-protected chiral edge state at high fields supporting both charge and spin currents.